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AVIATION

AND

AIRCRAFT JOURNAL

Navy Flying Boats at San Diego Ready for Panama Flight

VOLUME X
Number 3

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SPECIAL FEATURES

THE AIR MAIL AND AMERICAN AERONAUTICS
NAVY DESIGN COMPETITION FOR SHIPPLANE
THE RATEAU TURBO-COMPRESSOR
THE NAVY BUREAU OF ENGINEERING--1920
REVIEW OF AVIATION IN 1920

THE GARDNER, MOFFAT CO., INC.
HIGHLAND, N. Y.
HARTFORD BUILDING, UNION SQUARE
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Interior, Foreward Cabin of Aeromarine Navy 11 Passenger Flying Cruiser

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AVIATION
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Vol X JANUARY 17, 1921 No 3

The Air Mail Appropriation

IF the Senate should follow the lead of the House of Representatives and not allow any appropriation for the continuation of the Air Mail, American aviation would receive a set back that would need years to overcome.

No greater achievement in aviation than the successful carrying of the United States mails has been recorded in any country The pioneer work of the Post Office department deserves the support of every citizen who believes that the expeditious transportation of mail is a prime factor in the progress of any country.

The Air Mail as a postal convenience has proved its usefulness. Only a lack of knowledge of what is being accomplished would cause anyone to question the great service it is possible to render by a reasonable expansion of the transport of letters and packages through the air Other countries have looked at American Air Mail development with envious wonder at the success attained and followed the leadership that has been secured It is the one phase of aviation that can unquestionably be credited to this country.

If Senators and Representatives in their consideration of this aeronautical service will leave partisanship and political strategy out of their deliberations and credit the importance of the Air Mail as a national defense training school and as a secondary means of developing commercial aeronautics, they cannot but conclude that it deserves to continue and expand The Senate, it is to be hoped, will correct the error of judgment of the House of Representatives

The Value of Free Balloons

THE recent flight of a Navy free balloon to Hudson Bay caused some very unappreciative statements concerning the value of free ballooning. This was due to a somewhat general ignorance of the usefulness of a free balloon in practical aviation Nearly everyone admits that there is a big field for the airship in future commercial aviation. The best training for an airship commander in handling his ship is obtained from learning to properly handle a free balloon.

Many people who have never had any experience with balloons believe that the pilot of a free balloon has nothing to do. On the contrary, the duration and to some extent the course of the flight depend more on his judgment than on any other factor The proper amount of valving gas and dropping ballast determines the altitude of the balloon and the altitude of the balloon determines what wind currents the craft will sail with

An airship is, more or less, simply a balloon with propelling apparatus added Many phases of its operation are the same as the handling of a free balloon. Another feature is that an airship is far more expensive to employ as a training medium than a free balloon. It should be remembered that training flights are not made beyond civilization but are short ones near the training station. Longer flights such as these three naval officers made are attempts to increase records and secure information as to how unforeseen difficulties may be guarded against and overcome.

New York Air Ordinance

WHILE it is admitted everywhere that it is unfortunate to encumber the laws of the states and municipalities with regulations for aerial navigation, it has seemed necessary for some localities to have this done. Major F H. LaGuardia, president of the Board of Aldermen of the City of New York, who was in the Air Service during the War has prepared a simple and clear ordinance to regulate flying over New York. This bill which is published elsewhere in this issue limits flying to a safe and sane height and prevents any objectionable form of flying over the buildings and people of the city.

It is obvious that to enforce such an ordinance would require a useless patrol system, but it has the merit of letting aviators know what the city authorities require, and as the restrictions are moderate, it will probably need no enforcement

If other cities that are contemplating ordinances would follow the lead of New York, it would simplify the whole legislative situation The problem of altitude has been handled in a most conservative manner. Definite ceilings are usually subject to criticism but with gliding angles taken into account, much of the difficulty disappears. If these local efforts act as a spur to Congressional action, it will have accomplished much

Aircraft Appropriations

THE important aircraft appropriations for the fiscal year 1921-1922 are now undergoing the usual scrutiny of Congress. The Army and Navy are both requesting amounts which are needed for orderly maintenance and expansion of their services. The Post Office Department, the National Advisory Committee, and other government agencies are requesting money to spend on aircraft work Each is considered by a separate committee without close knowledge of what is done by the others It is the most inefficient method of handling any business proposition. Governmental aeronautics deserves consideration by a House and a Senate Committee and until it has this single and undivided attention there is sure to be waste by duplication of work authorized

At a time like the present, when economy is so necessary it is to be hoped that this defect in our national legislative procedure will be corrected. AVIATION AND AIRCRAFT JOURNAL has for two years been presenting every argument that can be made for these committees and if they are authorized, will consider that a great forward step has been taken.

The Air Mail and American Aeronautics

Captain Maurice G. Cleary, governing director of the Aero Club of America, has prepared the statement regarding the status of the Air Mail which follows.

The House has stricken from the Post Office Appropriation Bill the $1,250,000 designed to maintain and extend the Air Mail Service. The bill now goes to the Senate and unless this body restores at least a portion of the appropriation, American aeronautics will be deprived of practically the only encouragement it has received since the close of the war.

It is conceded that an aerial establishment is necessary to our national defense and it is impossible to obtain such an aerial establishment without the development of commercial aeronautics.

Foreign governments recognize in the transportation of mails by aircraft the most economical method of fostering civil flying and thereby providing for the safety of the nation. This was emphasized at the Imperial Air Conference, held in England last October.

The United States Air Mail is the most progressive, forward-looking and constructive aviation in the world today. It is the only aviation controlled by the Government that affords any hope of direct financial return. Not to continue and encourage it is most reactionary.

The United States was the first country in the world to establish a regular Air Mail Service—that between Washington and New York, which was opened May 15, 1918. Since then the Service has been extended to San Francisco, St Louis and Minneapolis and St. Paul. Thirty-five cargo carrying mail planes are in the air each day, flying a total of 8,000 miles.

The enterprise which the United States has shown in fostering the Air Mail has been an object lesson to other nations and since the experimental line between Washington and New York was started, England, France, Belgium, Germany, Italy, Switzerland, Czecho-Slovakia and the Scandinavian countries have established air mail routes, the most notable of which are those connecting London and Paris, Copenhagen, London and Amsterdam, Paris and Prague and the various ones between Berlin, Hamburg, Munich, etc., which are nurtured by the Germans insofar as the Peace Treaty permits.

America has ever been the first in the quickening of communications—as witness the steamboat, the locomotive, the motor car and finally the airplane. Military and naval leaders recognize in aircraft an indispensable weapon, which has the greatly enhanced value of strengthening itself through commercial growth, rather than through direct appropriations. The reaction from the war is not so persistent as to deny the wisdom of developing the art, if thereby national security can be improved and positive contributions be made to our crowded and overburdened systems of communication by rail and water or road.

The Air Mail operated for many months entirely—and will continue partly—on equipment for which no use could be found by the Army or the Navy. Its appropriation for the fiscal 1920 1921 totalled about $2,750,000. Of this amount about $1,250,000 became available for the trans-continental mail—New York to San Francisco—now in operation, $1,250,000 for equipment and maintenance of existing services, and $250,000 for an Alaskan route at the discretion of the Postmaster General. It is understood that a considerable portion of the appropriation remains.

For the year 1921-1922, the Air Mail asked $3,500,000. The House Committee on Post Offices and Post Roads cut this estimate to $1,250,000 and even this reduced amount was eliminated after brief discussion which indicated great lack of understanding, much misinformation and general insensibility and did not sufficiently take into account the broad argument of American aeronautics and the relation of its commercial development to the future prosperity and security of the nation.

The Air Mail as now operated daily touches both Atlantic and Pacific Oceans and communicates with Cuba and Canada—a grand total of 3,460 miles. The Post Office Department recommended the extension of Government operated routes between Boston and Detroit, by way of Buffalo; between Chicago and Los Angeles, by way of Kansas City; and between St. Louis and New Orleans, by way of Memphis. These routes were to be supplemented by others operated by private companies which would bring the total to 10,000 miles or more.

The Coast-to-Coast Air Mail provides the means for greatly reducing the time of rail transportation, and the introduction of night flying, which is imminent, will enable letters to be transported from New York to San Francisco in two days or less. During the calendar year 1920, the Air Mail carried about 104,000,000 letters with such dispatch that an increasing number of business firms are requesting that their mail go "via airplane," and are so stamping their letters.

The service which the Air Mail is rendering to commercial aeronautics can hardly be overestimated.

No proper aerial law exists which makes it possible for private commercial companies to obtain adequate credit or proper insurance rules. But by virtue of its being a Government enterprise, the Air Mail has been enabled to provide the one great and impressive demonstration from which to develop the practicability of commercial flight.

No proper air ports exist and private companies can not undertake to provide them any more than each steamship line can establish its exclusive harbor. The Air Mail has stimulated municipalities to establish local air terminals and these are today being used by such commercial lines as have been started.

The future development of aerial transport depends in considerable degree on the improvement of radio control, night-flying, etc. The Air Mail, cooperating closely with the Army and Navy, has developed such facilities in a practical manner.

The failure of the House to appreciate the full significance of the Air Mail is regarded by many as further indication of the confusion into which American aeronautics has fallen, in the absence of any definite policy of development which will take into account commercial advantage, military need and national economy.

Hecter Fuel and Export Aviation Gasoline

Report No. 90 of the National Advisory Committee for Aeronautics treats of aviation engine developments which for attaining higher power at altitude are following two principal lines, supercharging and increase in compression ratio. For the latter fuels have been demanded which are capable of operating under compressions too high for gasoline. Among the fuels which will operate at compression ratios up to at least 8.0 without preignition or "pinking" is Hecter fuel.

The Hecter fuel supplied by the Bureau of Mines for use in these tests was a mixture of 30 per cent benzol (C_6H_6) and 70 per cent cyclohexane (C_6H_{12}), having a low freezing point, and distilling from first drop to 90 per cent at nearly a constant temperature, about 20 deg. C, below the average distillation temperature ("mean volatility") of the X gasoline.

This comparison of the performance of the two fuels in an aviation engine was made in the altitude chamber at the Bureau of Standards, duplicating altitude conditions up to about 25,000 ft., except that the temperature of the air entering the carburetor was maintained nearly constant at about 10 deg. C. A Liberty 12-cylinder aviation engine was used, supplied with special pistons giving a compression ratio of 7.2 (the compression pressure measured by check-valve gauge was 170 lb. per sq. in.). Stromberg carburetors were used and were adjusted for each change of fuel, speed, load, and altitude so as to give the maximum possible power with the least fuel for this power. The tests covered a speed range of 1,400 to 1,900 r.p.m.

The results of these experiments show that the power developed by Hecter fuel is the same as that developed by export aviation gasoline at about 1,800 r.p.m. at all altitudes

Navy Design Competition for Shipplane

Rules for a Design Competition for shipboard airplanes have just been issued jointly by the Bureau of Construction and Repair, and the Bureau of Engineering of the Navy Department. Substantial payments are offered for designs finally accepted, and the competition marks an extremely interesting departure on the part of the Navy Department. The object of the competition is to secure new and original work of this highly interesting and valuable type of plane.

Rules for the Competition

The Navy Department invites United States citizens not in the employ of the government on aircraft work, or United States corporations, to submit designs for a shipboard airplane in accordance with these rules and specifications. Designs submitted will be judged by the Department in competition and the Department will purchase certain of them in accordance with the provisions of these rules.

The competition will be arranged in two parts—A preliminary examination and a final examination. Participation in the final examination will be limited to the successful competitors in the preliminary examination. No design at present being built under contract with, or previously submitted for consideration to, any branch of the government is eligible for this competition, the object of which is to obtain new and original work.

Commander Jerome C. Hunsaker, U S N
In charge Airplane and Airship Design, Bureau of Construction and Repair, Navy Department

Designs submitted in this competition shall be delivered sealed to the Bureau of Construction and Repair, Navy Department, on or before 12 o'clock noon of February 15, 1921, at which time the designs will be given preliminary examination by the Department. Those designs which do not include the drawings, calculations and other information here specified as required for the preliminary examination, or which otherwise do not comply with the conditions of the competition will be at once placed out of competition. Designs which comply with the conditions of the competition, but do not show sufficient merit for naval purposes to warrant further development will be placed out of competition. Designs placed out of competition will be returned. The department reserves the right to reject without explanation any or all designs on preliminary examination.

Designs approved after preliminary examination may be developed for submission to final examination. The Department may in its discretion make suggestions and criticisms in writing relative to such approved designs. Requests for technical information regarding this competition shall be made in writing to the Bureau of Construction and Repair and in no other way.

Designs approved in preliminary examination may be submitted sealed to the Bureau of Construction and Repair on or before 12 o'clock noon on May 1, 1921, at which time the designs will be given final examination by the department. The drawings, calculations and other information required on final examination are described below and any design which does not include such data in sufficient completeness, or which otherwise does not comply with the conditions of the competition will be at once placed out of competition.

Those designs which are accepted on final examination will be arranged by the Department in order of merit. The Department will contract to purchase the more successful designs, based on the order of merit established in the final examination, as follows:

First merit, $16,000.00; second merit, $10,000.00; third merit, $5,000.00; fourth merit, $3,000.00.

No payment will be made for any design which is not accepted on final examination. Not more than one design will be purchased from any one competitor, although there is no limit to the number of designs or variations of a design which one competitor may submit. In the event that more than four designs are accepted on final examination the Department will select the four most satisfactory designs for purchase.

The purchase of a design by the Department will be covered by a contract containing language as follows.

"Payment for the design shall, without further consideration, convey to the Department the non-exclusive ownership of that design, together with the right to use the same, and all information and data furnished, in any manner desired by the Department.

"The competitor whose design is purchased agrees to revise the design submitted in competition as may be required by the Department in so far as omissions, errors, inaccuracies or inconsistencies in the drawings and data are concerned and to supply corrected Van Dyke prints in duplicate (or ink tracings) together with full specifications necessary for the construction of a sample airplane."

All information furnished, other than drawings or charts, shall be typewritten on letter size sheets, and shall be accompanied by a statement that design has not heretofore been submitted for consideration to any branch of the government

Characteristics (Mandatory)

The following information is required for both the preliminary and final competitions

a. *Dimensions of the airplane*—Length of each panel, chord of each panel, span upper wings, span lower wings, gap, stagger in inches, dihedral in degrees, wing profile, distance from leading edge lower wing to rudder hinge, distance from leading edge lower wing to elevator hinge

b *Areas*—Area of each plane minus ailerons, area of each aileron, area of wings plus ailerons (total), area of horizontal stabilizer, area of elevator, area of vertical stabilizer, area of rudder, areas of body, boat and floats projected on end and to side

Power Plant (Mandatory)

The following information is required for both the preliminary and final competitions

a *Engine*—Name and model, manufacturer, normal b. hp at . . . . . r p m.

In case a foreign engine is used, reliable evidence must be submitted to show that this engine is available, including evidence as to its performance in official tests by any government testing establishment or scientific body of recognized standing

b. *Propeller*—Diameter, pitch, number of blades

c *Starting system*—A statement as to the type of starter contemplated.

d. *Fuel system*—A description of the kind of fuel system and pumps and the number and material of the tanks

Static Balance (Mandatory)

The following information shall be supplied for both the preliminary and final competition A tabulation of weights entering into the empty weight of the airplane together with their distances from the leading edge of the lower wing and their moments with respect to that point and a statement of the location of the center of gravity of the airplane with respect to the leading edge of the lower wing for both the empty and full load conditions

Weights (Mandatory)

The following weights shall be supplied

a. *Preliminary competition*—1 Weight empty statement (estimated) on Bureau of Construction and Repair Form SF-B 2. Useful load weight statement (allowable) consisting of the following items Crew, fuel (figured on 6 1 lb per gal) oil (figured on 7.5 lb per gal) ordnance, equipment

b. *Final competition*—1 Weight empty statement (calculated) on Bureau of Construction and Repair Chart SF-A 2 Useful load weight statement (allowable) as above except that the ordnance and equipment should be fully itemised

Performance (Mandatory)

The following calculations based on full load shall be furnished for both the preliminary and final competition

A Plotted (a) Characteristics of aerofoil combination used. (b) Velocity and lift drag ratio of airplane against angle of attack. (c) Horsepower available, horsepower required, wing drag, parasite drag and total drag, against speed. (d) Rate of climb and time of climb against altitude. (e) Curve of propeller efficiency

B Tabulated· (a) Detailed parasite resistance at 70 m.p.h. (b) High speed (m.p h) (c) Low speed (m.p h.), (d) Angle of maximum L/D (e) Maximum L/D. (f) Calculated maximum time in the air for full tanks. (h) Climb in 10 min. (i) Initial rate of climb (j) Absolute ceiling (k) Service ceiling. ($dh/dt = 100$ ft.) (l) Pounds per sq ft. (m) Pounds per h.h.p.

NOTE. Reference for authority shall be given for aerodynamic data used. Calculations should be in such detail that they can be checked.

Strength Calculations (Mandatory)

The following stress analyses shall be furnished for the final competition· A. Wing structure, B Tail structure, C Body structure, D. Landing Gear, several different conditions being considered for the analyses of each structural group

These calculations should be in such detail that they can be checked and data should be furnished relative to the strength of materials used.

Drawings (Mandatory)

The drawings submitted shall be made in accordance with the following list, which is considered to be a minimum

A. *Preliminary competition* (a) Front, side and top view of machine (dimensioned), scale ¾ in. = 1 ft (b) Typical beam section, typical rib, general type of body and float construction, scale 1½ in = 1 ft. (c) Longitudinal section through body of float to show location of ordnance and radio, scale 1½ in = 1 ft (d) Sketches of novel features for which special merit is claimed

B *Final competition*. (scale 3 in = 1 ft unless otherwise noted) (a) Front, side and top view of machine (dimensioned), scale ¾ in. = 1 ft. (b) Structural details of planes, (c) Structural details of ailerons, (d) Detail of interplane bracing, (e) Structural details of tail surfaces and supports, (f) Lines and structural details of body or boat, (g) Lines and structural details of landing gear, (h) Details of oil and water radiators, (i) Details of oil tanks, (j) Details of fuel tanks, (k) Drawing of propeller, (l) Installation drawing of engine, including starting system, cooling system, oil system, fuel system and engine controls, (m) Details of airplane controls, (n) Installation drawing of all controls and loads, (o) Details of furnishings, (q) Installation drawing of instruments, furnishings and wiring, (r) Bill of materials complete with all accessories, (s) Description specification of the airplane, giving full information as to the reasons for special features and special materials used

(A) Details of fixed gun mount. (B) Details of ammunition and ejector boxes (C) Installation drawing of fixed gun and synchronizer (D) Installation drawing of radio (E) Installation drawing of flexible gun, ammunition, magazine rack. (F) Installation drawing of hand fire extinguisher

In general, the final examination requires a complete specification and bill of material and a full set of construction drawings, including at least the information listed above in sufficient detail to permit a constructor of airplanes to build sample planes in accordance with the design So called production drawings are not required, and it is considered that about 50 drawings will suffice

Specifications for Design

Very full specifications for the design are given in which the exact functions of the plane from a naval standpoint are clearly indicated Also, while the specifications give every latitude to the designer, they indicate very clearly what are the desirable features of the plane These specifications are really admirably drawn The entire specification is so pertinent that a very full abstract follows

General

This specification is intended to describe a shipboard airplane which shall be used primarily for spotting, or the control of gun fire. For such spotting service, two men are required, a pilot to operate the plane and an observer to observe the splashes who will also operate the radio apparatus. The view for the observer must be excellent, especially over the surface of the sea. In an emergency the spotting plane may have to defend itself in the air from hostile aircraft and for this purpose machine guns are required. In the ordinary tractor type, this would necessitate a synchronized machine gun firing through the propeller under the control of the pilot and a scarff ring mounted machine gun for the observer who would fire to the rear and upward.

The arrangement of machine guns will, however, depart radically from this usual installation as the design differs from the conventional tractor type, and no restrictions will be made in these specifications as to the mounting of the machine guns, except to state that machine gun fire should be provided by the use of two machine guns to give the maximum protection against hostile aircraft. The view from the pilot's position as well as that from the observer's position should be considered with reference to the use of the machine guns.

It is intended to carry such a shipboard airplane on an aircraft carrier which is a flush deck vessel from which deck the plane will fly off and to which it will return. This requirement is a prerequisite for the design and may be considered mandatory as, unless the design is suitable for flying off and on a carrier, its performance so far as other features are concerned is of no interest. Landing on the deck of a carrier is considered to be the most difficult operation required of the type and designers are requested to give special consideration to providing an excellent view for the pilot forward and downward in order to facilitate making a landing on the restricted space available

The decks of aircraft carrier will be provided with arresting gear, but the design of such gear is no part of this competition and designers will assume that the arresting gear is such that a low landing speed or speed of the airplane relative to the deck at moment of contact is of the utmost importance It is considered that a minimum landing speed at moment of contact should not be more than 40 knots, and for the purposes of this competition it will be required as a prerequisite that the designer show by calculations that a sufficiently low speed landing could be made. In this connection it is pointed out that adequate control is essential in order that the plane will be under control at the low speed here required

The shipplane must be capable of taking the air from the deck of a ship and for this purpose two practices are contemplated The plane may be projected into the air by means of the standard Navy catapult having an acceleration equal to 64.4 ft per sec. per sec. at the moment of release a flying speed of about 45 knots. In other words, a plane to be suitable for launching from the catapult must be so constructed as to withstand the acceleration above stated when the plane is secured to a launching carriage actuated by the catapult, and, in addition, should have a wing area such that when launched at this speed the plane will immediately commence to climb

Alternatively the shipplane will take the air after a run along the deck of the ship of not more than 150 ft. when the ship is steaming at such a rate as to produce a relative wind over the ship's deck at 20 knots. A shipplane should be capable of being launched in either of the methods herein indicated

The shipplane in the course of its service will proceed off to sea out of sight of parent ship, but in the event of being unable to find the parent ship upon her return, exhaustion of fuel, engine failure, etc., it may be necessary to descend to the surface of the sea, there to float until assistance can be summoned by means of rockets or other signaling devices. For this purpose the plane must be built so that it will remain safely afloat in rough water for a long period of time It is desirable, but not considered essential, that the plane can rise from the surface of the sea under its own power

The conventional type of pontoon seaplane is considered to be fairly satisfactory so far as the feature of riding on the surface of the sea is concerned and any design, device or arrangement which can be shown to give an equivalent or better security when on the water will be favorably considered The present system of hydrovanes and external inflatable flotation bags applied to land machines is not considered satisfactory, and designs proposing such a type will not be approved on preliminary examination. In other words, the Department desires the development of a flotation system which shall be superior to the present system of hydrovanes and external air bags.

As the plane is to be used primarily for the control of gun fire, it will normally fly at reduced power and speed in order to keep the air for as long a time as possible. This places a premium on low hourly fuel consumption at cruising speed

As the shipplane is to be carried aboard ship where space is restricted, small over-all dimensions, and accessibility and simplicity of all parts are of great importance. In particular, the power plant and all power plant accessories should be as simple as is consistent with easy access for inspection and overhaul

To permit a large number of planes to be stowed in a given space; folding, detachable and demountable features are also of the greatest importance. It is desired that a ship plane may be taken down so that the individual parts are easily handled, but this requirement conflicts with another requirement equally important which is that the plane must be very quickly assembled with a minimum of time spent in adjustment or alignment. The shipplane must be a simple rugged construction which can be put together in such a manner that the use of plumb bobs, levels, trammels, etc. for alignment after assembly is entirely unnecessary.

The high speed and ceiling should be as great as is consistent with maintaining the ability to land upon and to take the air from the deck of a ship

In judging designs the Department will give weight to the following considerations in the order given

(a) The construction of the shipplane must be rugged and dependable and, furthermore, capable of being easily and quickly taken down and re-assembled, and when taken down, suitable for compact stowage aboard ship The requirement for reliability and suitability for conditions aboard ship is of first importance.

(b) The shipplane must be by its design especially suitable for flying from the deck of a vessel either directly or assisted by a catapult, and further adapted by its positive control and low landing speed for alighting on the deck of the ship In an emergency the shipplane must alight in the water

(c) In the event of an emergency landing at sea, the shipplane must provide reasonable safety for the personnel and a reasonable chance for salvaging the machine in an undamaged condition

(d) Air performance should be the maximum consistent with the prerequisites mentioned above. Under air performance will be considered endurance in the air, maximum speed, maximum ceiling, maneuverability and general suitability for the primary function of spotting gun fire and the secondary function of aerial combat

General Arrangement

Arrangement of Cockpits—The shipplane is desired to be a two-place machine carrying one pilot and one observer with their cockpits placed as near together as possible in order to facilitate communication The view for the observer must be excellent over the surface of the sea and the view for the pilot must be excellent forward and downward in order to reduce the risk of landing on a ship's deck

Ordnance—Two machine guns shall be installed in such a manner as to provide for the maximum protective area of fire.

Landing Gear—The landing gear shall be such as to enable the machine to take the air from land, or from the deck of a ship, and to return to land or the deck of a ship and, in an emergency, to alight upon the water and to remain there safely afloat for a long period of time. It is desirable but not essential, that the plane be able to rise from the surface of the water under its own power

Hoisting—The design shall be such as to permit hoisting from the water by a crane without damage to the general structure. In this connection ample provision for rapid drainage of water must be provided

Dimensions—The overall dimensions of the shipplane shall be as small as possible and arrangements for take-down to permit compact stowage are very desirable.

Accessibility.—All parts shall be as simple and accessible as is consistent with good practice especially in the case of power plant and power plant accessories. Compactness of installation, however, shall not be permitted to interfere with easy access for inspection and overhaul.

Special Features—Folding wings, detachable and demountable wings, fuselage, tail surface, etc., are looked upon with favor and should be incorporated where practicable.

Assembly.—The shipplane shall be so designed as to be quickly assembled without necessity for adjustment or alignment and without the use of plumb bobs, levels, trammels, etc.

Catapult—The construction shall be such as to withstand the force produced by an acceleration of 64.4 ft. per sec.

Material—The materials used in the construction of these machines shall be chosen with special reference to their resistance against corrosion, humidity and hot sun light due to salt air, salt water and tropical climates. In general, metal suitably protected against attack by corrosion is preferred and although veneer covered wings are preferred to fabric a suitable metal covering is preferred to either.

Load Factors and Design Loads

(a) The following load factors are required as a minimum for the wing truss.

Condition	Load Factor
Low speed	7
High speed	6
Diving	1½ times the weight of machine in drag on the wings.
Inverted	4
Front lift wires (double)	4 each (low speed condition)
Rear lift wires (double)	3.5 each (high speed condition)

(*b*) The horizontal stabilizer shall be designed for a uniform load of 35 lb per sq ft.

(*c*) The elevators shall be designed for an average load of 35 lb per sq ft. with a distribution varying uniformly from a maximum at the hinge to zero at the trailing edge

(*d*) The vertical stabilizer shall be designed for a uniform load of 30 lb per sq ft.

(*e*) The rudder shall be designed for an average load of 30 lb per sq ft with a distribution the same as for the elevators

(*f*) The ailerons shall be designed for an average load of 25 lb per sq ft. with a distribution the same as for the elevators

(*g*) The stresses in the body and landing gear, if for a land machine shall be calculated for the following conditions and each member shall be designed for the worst stress imposed by any condition 1. Three point landing, shock absorbers fully extended and reactions perpendicular to top longerons. 2. Two point landing, shock absorbers fully extended, propeller axis horizontal and reaction passing through the center of the axle and the center of gravity of the machine 3 Air force due to the specified down load on the tail surfaces. 4. Air force due to the specified side load on the tail surfaces. 5. Static thrust of propeller and corresponding engine torque combined with dead weights 5 Side landing, shock absorbers fully extended, force equal to twice the weight of the airplane applied through the center line of the axle.

The stresses in the body and landing gear if for a seaplane shall be calculated for the following conditions and each member shall be designed for the worst stress imposed by any condition. 1. Propeller axis horizontal and reaction vertical and passing through center of gravity 2 Propeller axis horizontal and reaction passing upward and backward through the center of gravity in such a manner that the tangent of the angle which it makes with the vertical is equal to 0 25 3 Air force due to the specified down load on the tail surfaces. 4. Air force due to the specified side load on the tail surfaces 5. Static thrust of propeller and corresponding engine torque combined with dead weights. 6. Side landing; side load equal to twice the weight of the seaplane distributed equally between twin floats or applied to the main float

For conditions (1) and (2) of both land planes and seaplanes the loads at the panel points should be parallel to the ground reaction The distribution between the upper and lower panel points of the parts of a load shall be taken in general to be inversely proportional to the distances from the load to the panel points. For condition (3) the parts of the body forward of the wings and to the rear of the wings shall be treated as a cantilever fixed at the lower wing spars and the load due to the air forces on the tail shall be assumed to be applied at the tail post Condition (4) is to be figured in a manner corresponding to that for condition (3) Condition (5) is to be figured in a manner corresponding to that for condition (3). Condition (6) is used primarily for calculating the cross bracing of the landing gear and fuselage

The longerons between supports shall be computed as pin end columns. Allowance shall be made for the bending moments introduced by eccentric fittings if any, and by any curvature of the longerons between strut points.

Load Factors

Conditions	Load Factor
(1)	8
(2)	8
(3)	1
(4)	1
(5)	3.5
(6)	1

Power Plant

Engines. The engines to be used shall be restricted to those which are on the market, but these engines need not necessarily be made in the United States, although the use of an engine made in the United States will be considered an advantage for any given design The use of any particular type of engine shall be approved by the Department.

The ignition system shall be confined to the engine compartment and mechanically controlled from the pilot's cockpit.

In connection with the engine installation special attention shall be given to the matter of fire prevention by the use of proper exhaust manifolds, carburetor intakes, fuel drip drains and fireproof bulkheads

Starting System Provision shall be made for starting the engine by means of a hand magneto installed in the pilot's cockpit.

Cooling System. The cooling system shall be equipped with means for regulating the amount of cooling

Fuel system The fuel tanks shall be of the self-sealing type. (An allowance of ½ in is to be made for tank walls and 1.6 lb per gal of total tank capacity for the tank weight) Air pressure on self sealing tanks is prohibited

Fixed Equipment

Furnishings The seat shall be designed for seat pack parachutes. A stool or collapsible seat shall be provided for the observer and shall be so designed that it will not interfere with the movements of the observer when operating either the gun or the radio Suitable wind shields shall be provided for the crew

Instruments The usual instruments are provided for, with a weight allowance of 30 lb.

Controls The controls to be installed in the pilot's cockpit shall be of the stick type with rudder bar. Rigidity to be maintained and all bearings generously proportioned to reduce wear.

Ordnance. Two machine guns will be provided, either fixed or flexible The normal armament for a plane of this type is one fixed gun controlled by the pilot and one flexible gun operated by the observer, but any arrangement will be considered Five hundred rounds of ammunition should be allowed for a fixed gun and 300 rounds for a flexible gun.

Spotting Equipment includes radio telephone and telegraph, Very's signal pistols and similar items.

Useful Load

Crew	360 lb.
Fuel and Oil (4 hours at full speed at sea level)	lb.
Ordnance	lb.
Equipment	150 lb

Performance

The machine at the gross load figured in accordance with these specifications shall be capable of taking the air under either of the following conditions (a) After a run along the deck of a ship of 150 ft. when the ship is steaming at such a rate as to produce a relative wind over the ship's deck of 20 knots; (b) After having been projected into the air by mean of a catapult giving at the moment of release a speed of 45 knots.

The machine shall have a minimum landing speed at the moment of contact of not more than 40 knots.

The high speed and ceiling shall be as great as is consistent with attaining the above requirements.

Additional Data Supplied

The additional data supplied includes a detailed list of items included in the spotting equipment and for the ordnance, and specifications for electrical bonding of airplanes. Notes are also given on fixed guns; on synchronizing gears and as flexible guns.

NC-5 in Fast Flight

The United States naval seaplane NC-5 flew from San Diego, Cal., to Magdalena Bay, Lower California, in 9 hours and 15 minutes on January 1. The plane covered the 702 miles at an average speed of 72 miles an hour.

The Rateau Turbo-Compressor

By H. M. Buckwald, M. E.

Several weeks before the Armistice was signed, the Rateau Turbo-Compressor was placed on French bombing planes. Two hundred were ordered by the French government and eighty were delivered before Nov 11, 1918

During the last year of the war, fighting took place above 15,000 ft., where the motive power was low and the engine sluggish. The airplane's climb and manoeuverability were therefore poor, unless it was fitted with a supercharger for restoring the motive power The supercharger is a device by means of which the engine can be made to operate under sea-level conditions and therefore deliver normal horsepower, irrespective of the altitude at which the engine happens to be. Supercharging means sending into each cylinder a greater weight of air than ordinarily would be drawn in, as the piston descends on its suction stroke Superchargers at present deliver normal power up to 18,000 ft., after which the power declines.

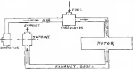


Fig. 1

Various means have been suggested as to how this could be done, for example the running of an air compressor directly connected to the engine. However calculations show that in order to assure constancy of engine torque up to 18,000 ft., that is to double the air pressure, it would be necessary to expend approximately, 15 per cent of the motive power Also this method would necessitate a change of speeds for coupling the turbo compressor, or else there would be great inconvenience at the start, by the power absorbed by the compressor Other inconveniences here would be the excessive weight and volume, also its lubrication would cause oil to get mixed in with the air sent to the carburetor. There would also be difficulties of assembly, of arrangement in the fuselage, and the necessity of rebalancing the airplane.

Fig 2

Fig 3

This method which has the greatest number of advantages is that first put into practice by Mr Rateau, namely the use of the energy of the exhaust gases. This method is simple in all of its details. There is plenty of power available in the exhaust gases. A simple gate-valve regulates the speed of the device, it weighs very little, and is, usually placed between the V of the engine, also the airplane's balance need not be changed Piping is reduced to a minimum Thorough and severe tests have shown that there is no need to fear gyroscopic effect, the raised temperature of the exhaust gases, nor the temperature of the compressed air Indeed the elevation of the temperature of the air entering the carburetor is useful

In a recent note to the Academy of Sciences, Mr. Rateau stated that the efficiency of a turbo-compressor was unlimited At present, the normal power is conserved up to 18,000 ft., but this value can be raised, it being only a question of the size of the distributor of the turbine At all altitudes the engine operates under sea-level conditions, that is up to the altitude for which it was designed. The carburetor receives its air at sea-level pressure, and the engine exhausts at sea-level pressure,

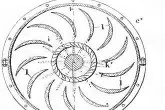


Fig 4

and the motor continues to develop its normal horsepower Thus an airplane with a comparatively light engine can fly at high altitudes, where without a supercharger, a heavy high-powered engine and consequently a heavy structure for the fuselage and plane, would be required.

Mode of Operation—The supercharger consists of a gas turbine and a centrifugal air compressor, both mounted on the same shaft. The exhaust gases impinge upon the turbine buckets and set the combination of turbine and compressor turning The compressor collects the surrounding air, compresses it, and sends it to the carburetor It is a very simple device, with only one moving part. Another advantage is that it acts as an excellent muffler Fig 1 shows the principle of the cycle

The superchargers effect on the motive power—There is no gain in supercharging an engine at sea-level. As this would cause preignition, all of the exhaust gases are therefore allowed to escape. As the airplane rises, the pilot turns a handle and gradually opens a port directing the gases on to the turbine buckets, and thus the normal power is maintained up to 18,000 ft., when the port is wide open and all of the exhaust gases enter the turbine.

In Fig 2, curve *A* shows the power variation without, and curve *B* the variation with the supercharger Without the supercharger, there is a gradual dropping off of power With the device, it is only above 18,000 ft. that the normal power

decreases, but it is double what it would be if there were no supercharger Take for example a 400 hp engine. Its power ordinarily at 18,000 ft., is 200, at 36,000 ft., 100 With supercharging, this engine will deliver 400 hp from sea-level up to 18,000 ft. At 36,000 ft., the power will be 200

Power to run a turbo-compressor—Instead of the back pressure during the exhaust stroke being the actual atmospheric value at which the airplane happens to be, the engine always exhausts at sea-level pressure, and the resulting loss of horsepower is the amount that the supercharger requires the engine to expend in order to run it. The turbine receives the gases on its buckets at sea-level pressure, and exhausts these gases at

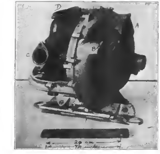


FIG 5
A—AIR INTAKE *B*.—AIR OUTLET *C*—EXHAUST GAS INTAKE *D*—EXHAUST GAS OUTLET

the altitude pressure The energy of the exhaust gases are used in two ways, first the difference between the sea level pressure and the actual atmospheric pressure, and second, the expansion between these two pressures, The gas turbine uses this energy which would ordinarily be wasted

Constructional Details—Much difficulty was encountered in finding a suitable metal to withstand the heat of the exhaust gases. As the metal became heated, its resistance to the stresses caused by centrifugal force diminished. On leaving the cylinders, the temperature of the gases is approximately 1000 deg F Because of radiation in the exhaust pipes between the engine and the turbine, the temperature of the gases impinging on the buckets is about 1,300 deg F Because of this excessive temperature and the high rate of revolution of the turbine, the necessity for a high resisting metal can readily be seen However an alloy steel has been found that is very satisfactory, and now the supercharger may be said to outlast the engine to which it is attached The turbine casing, wheel and buckets are of this steel The buckets are jammed into the wheel as shown in Fig 3 They have staggered bases in order to give more strength and more efficient cooling, the idea being to surround each blade with as much metal as possible for conduction of the heat. There are no nozzles, the gas being directed on to the buckets by concave scoops arranged around the circumference

The compressor casing is of aluminum. The compressor wheel is of steel and comprises eight straight blades. It is made entirely of one piece, the whole being milled. On the compressor end of the shaft is a thrust bearing; on the other end is a tachometer attachment. Lubrication of the apparatus is by means of the pressure oiling system of the engine. A manometer on the dashboard tells the pilot at what speed the turbine should run. A handle is turned which allows less exhaust gas to escape into the air, and instead to be directed into the turbine. A tachometer is mounted on the dashboard

The superchargers constructed up to the present, restore the normal horsepower up to 18,000 ft. where they revolve at 25,000 to 30,000 r p m. Three types have been constructed, all turning at the same speed. Number one is for engines of 175 hp Number two is for 300 hp engines, while number three

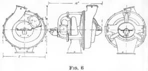


FIG. 6
A—AIR INTAKE *B*—AIR OUTLET *C*—EXHAUST GAS INTAKE *D*—EXHAUST GAS OUTLET

is for 450 hp Numbers one and two weigh 51 lb with manifolds and with instruments. Number three weighs 77 lb.

History of the Rateau Supercharger—The first models of 1916 were designed to deliver normal horsepower up to 13,000 ft. Here the atmospheric pressure is 9 lb per sq in and the temperature —12 deg F The power to run the turbine was obtained by the expansion of the exhaust gases between the pressures of 14 7 lb. per sq in. at the turbine inlet and 9 lb. per sq in. at the outlet

The first machines constructed were given numerous preliminary tests at Paris, during several months. They were first given bench tests, using steam to drive the turbine Although the normal number of revolutions is between 25,000 and 30,000, in this case it was carried up to 45,000 r p m in order to determine the equilibrium, the resistance of the metals to centrifugal forces, and the strength of the whole system, and also the capacities, the pressures and efficiences of the device at different speeds. A small chamber was arranged at the compressor intake, and the air which entered this chamber could be throttled, and so lower the pressure. Inside of the chamber there was a screen upon which the entering air struck, in order to dampen out the speed At the outlet of the compressor, the delivery of air was measured by a calibrated pipe 2 75 in. in diameter. The pressures and temperatures of the air were carefully measured in the chamber and the calibrated pipe. The engine used in these experiments was a 100 hp 8-cylinder Vee, Lorraine-Dietrich, of 1400 r p m These steam tests showed that when turning at 25,000 r p m , the compressor gave a sufficient quantity of air at sea-level pressure

FIG 7
TURBINE AND COMPRESSOR WHEELS

The compression of the air raised its temperature considerably. From 77 deg F. to 122 deg F, the torque of the engine is not materially effected. From 122 deg F it dimishes, but slower than the density of the air entering the carburetors. Early tests seemed to show that the engine was not affected by the high temperature of the air, but now all of the apparatus are equipped with air radiators.

While conducting the ground tests, in order to have a low pressure at the turbine outlet, a suction pump was connected which sucked out the exhaust gases. Inasmuch as these gases, as they leave the turbine, have a high temperature, about 1,100 deg F , and would therefore ruin the pump, they were cooled by injecting water into the manifold.

Gyroscopic Tests—When the airplane turns quickly or loops, the revolving parts of a turbo-compressor are subjected to gyroscopic couples. In order to find out how the apparatus would act under these conditions, it was pivoted vertically and submitted to rapid oscillations of 60 deg amplitude. Turning at 30,000 r p m. is supported without inconvenience, a rotation perpendicular to its axis, at the speed of a complete turn in one and one-half seconds This is four times more rapid than the greatest speed of rotation possible in turns of an airplane Also it will be noticed that the testing with oscillations is much more severe then in continuous rotation.

Mountain Tests—After the factory experiments were finished, the tests were continued at Galibier mountain in the French Alps, altitude 7,100 ft., which is the highest point in France accessible by a road The accompanying photograph, Fig 8, shows the Lorraine-Dietrich 8-cyl., 160 hp engine and apparatus mounted on the truck. For the sake of convenience the supercharger was placed to one side of the engine and not in its proper place The engine is mounted on a balance bench, the arm of the balance being 3 28 ft. The torque of the engine could thus be measured. At the top of the exhaust manifold, the sliding valve which permits the free escape of the exhaust or the sending of the desired quantity to the turbine can be seen When the engine was supercharged, the fuel tank was made air-tight and connected by an equalizing pipe, with the outlet air of the ventilator

The altitude of 7,100 ft., which is much inferior to that at which the supercharger must normally work, was insufficient to obtain the speed and the maximum pressure that should be obtained. The highest speed obtainable was 22,800 r p m and produced an excess pressure of 10 2 in. of mercury Nevertheless the tests showed the efficiency of the apparatus and the modifications of detail necessary It was found that

1—Intake and exhaust manifolds had to be made perfectly tight It was necessary to reinforce the exhaust pipes and also the fuel tank

2—The excess of pressure caused leaking of fuel at the carburetors, which therefore had to be made tight The jets had

FIG 8
THE MOUNTAIN TEST EQUIPMENT

to be modified, and it was found desirable to place the carbureters at the front of the motor instead of at the rear

3—Inasmuch as the engine gave a greater power than ordinarily, the water radiators should be made larger.

Below are the results of a test made in which the gas valve was suddenly shut off. The developed horsepower of the engine passes in a few seconds from 111 to 164 hp. with an increase of speed from 1370 1550 r p m. In this test the speed did not reach 1000 r p.m. because the carburetor was not adjusted

TEST AT GALIBIER, AUG 6, 1917 BAROMETER, 22 2 IN OF MERCURY
TEMPERATURE 48 DEG F

		Without supercharger	With supercharger
Speed of engine	r p m	1370	1550-1550
Weight on balance arm	lb	126	168
Pressure at carburetor inlet		0	10 4″Hg
Power	hp	111	164
Temperature of compressed air			187 °F

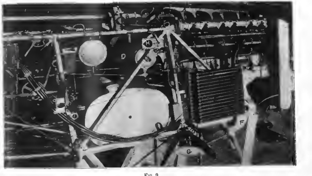


FIG. 9
1—EXHAUST GAS COLLECTOR *B*—GAS TURBINE *C*—AIR COMPRESSOR *T*—AIR INTAKE *D*—EXHAUST GAS OUTLET *E*—AIR RADIATOR *F*—COMPRESSED AIR CONDUIT *G*.—FUEL PUMP *H*—EXHAUST CONTROL VALVE

The fuel consumption remained practically the same as at the ground, about 3.75 U. S. gallons per minute, in spite of the increased power. The rise of temperature of the compressed air did not cause much trouble. A small radiator was added which easily reduced the temperature to 104 deg. F only, which permitted another increase of the engine's power.

At present, the Nieuport air radiator has about 1.9 sq. ft. of

FIG. 10

A—AIR INTAKE. B—AIR RADIATOR. C—OIL RADIATOR. D—WATER RADIATOR. E—FUEL PUMP. F—EXHAUST CONTROL VALVE

surface, and the Breguet, 14 sq. ft. The temperature of the air at the compressor outlet is approximately 210 deg. F and at the carburetor inlet 85 deg. F.

Flight Tests with the Rateau Supercharger.—In March 1918, flight tests were commenced with the Breguet biplane and supercharger. These flights were made at Villacoublay near Paris, by Lieut. Canivet. The fuel piping and the intake manifold were not tight when the engine was supercharged. This resulted in fuel leaks sometimes near the hot exhaust pipes. These first experiments were made at the peril of the pilot's life, and he was ordered by superior officers to carry a parachute. Also in order to avoid fire danger, the gasoline pump was mounted outside of the fuselage. It could thus be gotten at more easily for adjustment. In the Breguet, it was mounted on a landing gear strut, in the Nieuport, it was placed on the wing's leading edge.

Test with a Breguet Biplane.—A Breguet 14 B 2 fitted with Rateau supercharger and a Renault 300 hp. engine of the following specifications was used: Wing surface 512 sq. ft., total weight 3,750 lb., wing loading 7.32 lb./sq. ft., useful load 680 lb., weight of fuel 475 lb., total charge 1,155 lb., Ratier propeller 9.3 ft. diameter, pitch at 3.28 ft., 7.75 ft., width of propeller at 3.28 ft., 7.75 ft., r.p.m. at fixed point 1310.

Altitude Km.	Altitude Ft.	Climb: Time minutes and seconds	Climb: R.p.m. of engine	Horizontal Speed M.p.h.	Horizontal Speed R.p.m.	Pressure in lb. at the carburetor during the climb
[illegible]	164[illegible]	[illegible]	11[illegible]			
1	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	14[illegible]	102	1380	385
[illegible]	[illegible]	[illegible]	14[illegible]			504
[illegible]	111[illegible]	[illegible]	[illegible]	117.5	1580	77
[illegible]	[illegible]	[illegible]	[illegible]	120	1005	848

[illegible] valve was never completely closed. Horizontal [illegible]

[illegible] WITH AND WITHOUT SUPERCHARGER

	Breguet plane	Breguet plane with Rateau device
[illegible] (16,411 ft.)	47½ mins.	27 mins.
Horizontal speed [illegible] (16,411 ft.)	91 miles per hr.	120 miles per hr.

Deductions from Tests.—The following theoretical results are probably applicable to any airplane, and are confirmed by flights on the Breguet.

1.—The supercharger [illegible] its accessories, its weight, its resistance to advancement diminishes the ceiling of the airplane without supercharger approximately 10 per cent.

2.—The new ceiling is increased 15,000 ft. by the use of the supercharger which doubles the power of the engine above 18,000 ft.

3.—The speed at the ordinary ceiling (using the same propeller as with the supercharger) is increased 50 per cent by the use of the supercharger.

4.—The speed at the new ceiling is increased 25 per cent with respect to the old ceiling.

The Navy Bureau of Engineering-1920

With a view to providing a suitable power plant for aircraft of apparently ever increasing size, the Navy's Bureau of Engineering has taken up the question of multi-engined power plants driving a single propeller with a view to using either a single unit of this type in large craft, or a number of such units. During the year, such units have been under development and construction, the types developed including those suitable for installation in both seaplanes and airplanes and types for installation in rigid or non-rigid airships. There appears to be every reason for expecting these installations to operate with an efficiency much improved over that obtainable with a multitude of single engine installations making up a power plant, with a considerable reduction in gross weight and a much reduced degree of complication.

Immediately following Congressional authorization for the construction of a rigid airship by the Navy Department, the work of detailing and elaboration of the preliminary power plant designs for this airship was proceeded with. The general arrangement and details were completed. Engines and transmission and propeller arrangements were worked out and construction proceeded with, every effort being made to make the greatest possible use of the information obtainable from existing rigid airships, eliminating defects found in service in airships of foreign design and construction, adapting the apparatus to American methods of manufacture and operation, and incorporating certain improvements that it was believed would result in the government obtaining in the first rigid airship constructed in the United States, an airship superior in every respect to the corresponding types in foreign service.

The development and construction of the Liberty engine having geared propeller drive has been completed and the engines are now available to the service. The increase in economy and propeller efficiency obtained in the geared engine thus far indicates the great value of this type for aircraft of long cruising radius and moderate speeds, the improved performance more than offsetting the small increase in weight involved.

As a necessary part of the rigid airship construction program, the development of engines especially designed for use in this type of craft has been undertaken and, at present, two such developments are in hand and progressing favorably.

The most interesting feature of the current year's development has been the very generally favorable progress made in the air cooled engine field. As a result of very much greater study devoted to this type of engine in the United States, aviation may very shortly expect to have available air-cooled engines of domestic manufacture equal in performance to the better types of water-cooled engines now in current use.

The reaction of this improvement of the air-cooled engine on the design of water-cooled engines should prove of great interest, since, if the water-cooled type is to retain the predominance it now holds in certain parts of the field of aviation activities, designers will, of necessity, soon be forced to further refinement and improvement of the water-cooled engine.

From both economical and endurance considerations, the desirability of evolving engines for aviation purposes using fuel less costly, in more abundant supply, and less hazardous in use, than gasoline has become apparent, and this question has been taken up and developments are proceeding with a view to providing power plant apparatus from which gasoline fuel will be eliminated.

Investigation of material and methods of construction for propellers of all sizes, with a view to reducing the cost of production, decreasing the time required in manufacture, and increasing the durability and efficiency of the product have been carried on. In this investigation the closest cooperation with the Air Service of the Army has been had, while the services of the Forest Products Laboratory, at Madison, Wis., has been very valuable. There have been most interesting developments in metal propellers, in propellers of special composition materials, and in variable pitch propellers.

The Aeronautical Engine Testing Laboratory at the Navy Yard, Washington, has been continuously engaged in the testing of engines with a view to their improvement in economy and endurance, the testing of ignition apparatus and accessories, and in the development of certain special apparatus such as dynamometers for use in aircraft while in flight. In conjunction with the Bureau of Construction and Repair, the wind tunnel at the Navy Yard, Washington, has conducted a number of valuable tests on cooling systems from which very complete design data have been obtained which will result in very material improvement of the cooling systems of future installations.

The Laboratory at Washington, as well as the U. S. Naval Engineering Experiment Station, Annapolis, Md., has been engaged in a continuing series of research and tests on the materials entering into power plant construction and operation. A great deal of time and effort has been expended in this manner on fuels, lubricants, and light weight alloys, every effort being made to assist industrial organizations engaged in these fields who wish the assistance of the bureau's testing and research facilities, or who might be engaged in supplying the department with materials of this type.

The increasing size of aircraft, together with the much more general application of electricity, has resulted in the bureau developing electric generating sets driven by independent engines, the entire unit being designed with a view to extremely light weight, accessibility, great endurance, economical operation at wide range of altitudes, and of such form as to be suitable for installation in aircraft.

The same considerations have led to the development of instruments for aviation purposes very closely paralleling in their functions the ship-control instruments found in surface craft. The possibilities in the way of lightness of construction for satisfactory operation compared with instruments used in ships has been rather a surprise even to the designers of such apparatus.

The importance of conserving hydrogen in the operation of airships of both rigid and non rigid type has led to elaborate experiments in the possibility of compensation for the loss of weight due to consumption of fuel by the recovery of water from the engine exhaust gases and this work is proceeding with a view to reduction in the weight of the apparatus, rendering it more compact and, aerodynamically, more efficient. The functional operation of the apparatus has been a complete success.

Jointly with the Air Service of the Army, and utilizing some of the facilities of the Bureau of Mines, an exhaustive development, having in view great improvement in economy in the production of hydrogen, is in hand, and reductions in cost of the order of 50 per cent do not appear to be more than can reasonably be expected.

The bureau has enjoyed the cooperation of certain manufacturers of hydrogen generating apparatus which have materially decreased the time required for this work, which will, no doubt, result in benefits equally as great to commercial producers of hydrogen as to aviation in general.

Experimentation and production of helium as a medium for the inflation of lighter than aircraft is proceeding, one plant being designated a production plant and the other an experimental plant. A third plant that was, at one time, in operation has been dismantled and other use made of the apparatus. A thorough survey of the probable sources of helium supply has been made.

From time to time, small quantities of helium have been supplied to various laboratories and commercial organizations for their use in general development work and research. In all cases, helium has been supplied to these users under such conditions as will assure the government of complete information covering the results of the research and development undertaken, as well as periodic progress reports covering such work.

Very close cooperation has been had with the Air Service of the War Department in the selection of development and research problems to be undertaken either by the War Department or by the Bureau of Engineering of the Navy Department, with the result that there has been no duplication of effort and that all developments carried on by either service have been executed with a view to incorporating such features as the other service might consider necessary to making the resulting apparatus, or data, of the greatest possible value. The transfer of materials from one department to the other has materially facilitated operation, and the mutual support and benefit derived from the relation between the two services has brought clearly to view the great difference in the requirements of the two services due to the difference in the operations they are required to carry on.

Every effort has been made to assist the Postoffice Department in its Air Mail Service undertaking. The facilities of the Bureau of Standards and of the Bureau of Mines, together with the services of the Bureau of Engineering's own inspection service, the Aeronautical Engine Testing Laboratory at Washington, and the Naval Engineering Experiment Station at Annapolis, have been of very great value.

The development in radio on aircraft during the past year has been mainly along the following lines: Lightening of radio apparatus, improvement in the receiving apparatus to permit of a longer range of reception on a plane, elimination of ignition noises present in the receiving set thus giving better reception, development of the aircraft radio compass which permits a plane to fly toward the sending radio station and to plot its own position by means of crossed bearings from two or more radio stations, improvement in the intercommunication sets on board large aircraft to permit better communication among the different members of the operating crew, and the development of an emergency set for use on large seaplanes which are disabled on the water at a distance from their bases.

The general industrial condition existing during the past year has, at times, operated as a serious handicap to the activities of the bureau. This has been particularly apparent in the machinery, metallurgical, and rubber industries. Every effort has been made to cooperate with the aircraft and underlying industries to the fullest extent possible, and it is hoped that a general stabilization of business industries in the near future, with a more definite determination of a continuing policy on the part of governmental aviation, will eliminate many of the undesirable conditions with which the aircraft industry has found itself confronted.

Airplane Engines to Be Sold

Between 1,500 and 1,600 airplane engines of foreign construction, ranging from 90 to 400 horsepower, acquired by the War Department since April 6, 1917, have been declared surplus and soon will be advertised for sale by the Surplus Property Division, Office of the Quartermaster General. The disposal of this class of material has heretofore been confined by the War Department to the United States, but this lot, together with 2,448 American-made engines of forty-five and ninety horsepower, will be advertised in South America, France and England as well as in the United States. The foreign models are of French, English and Italian design, and the United States models are the Hall Scott and the Lawrence. In addition to the engines to be sold there are some old airplanes of French and German design, including the German Albatross, the Halberstadt and Rumpler, and the French Breguet and Nieuports.

Aerological Service in Rockies

A branch of the Helena, Mont., office United States Weather Bureau, will be established at Blossburg, on the summit of the Continental divide, for observations of air currents and other details which will be used in charting a safe route for airplanes above and across the Rockies.

New York Regulates Flying

F. H. La Guardia, president of the Board of Aldermen of New York and a veteran of the United States Army Air Service introduced on January 11, in the board a proposed ordinance governing air traffic over New York city. The regulations are the result of conferences between Mr. La Guardia and representatives of the Air Service of the Army, practical fliers and airplane builders.

The ordinance was referred to the board's committee on general traffic, of which Alderman William T. Collins, Democratic flood leader, who also served as an aviator in the war, is chairman. The measure is expected to be reported out for vote of the board within two weeks. A number of other cities are awaiting New York's action on regulation of air traffic as a model for similar laws.

The proposed ordinance prohibits stunt flying over the city, any flight at less than 2,000 feet of altitude, the dropping of ballast, instruments, tools or other matter from aircraft passing over the city, provides that aircraft approaching each other shall turn to the right; gives lighter than air craft the right of way, and provides a penalty of not less than $50 fine, imprisonment not exceeding a year, or both.

The text of the ordinance follows:

"Be it ordained by the Board of Aldermen of the city of New York as follows:

"Section 1—That until the Congress of the United States passes legislation to control and direct the operation of all aircraft over the territory and territorial waters of the United States, at which time the provisions of this ordinance shall automatically cease and become void, all aircraft operating from or over the geographical limits of the city of New York shall be governed by the following conditions and terms:

"Section 2—For the purpose of this ordinance the term 'aircraft' shall mean any airplane, hydroairplane, sea plane, dirigible, balloon or other apparatus carrying one or more persons into or through the air, propelled by currents or by power or motors contained in said apparatus. The term 'pilot' shall include every person who, being in or upon any aircraft, undertakes to direct its ascent, flight or descent in the air, and the word 'flight' shall include every kind of locomotion by aircraft. A known, established, recognized field or place of landing shall mean a public or private field or place of landing for such purpose where the landing of airplanes is permitted by the owners thereof, and such fact is publicly known. An 'emergency' place of landing is any place where a landing may be effected in an emergency without endangering in any way life or property on such place of landing. 'Limits of the city of New York' shall mean the land or air above the land or pier heads of any of the five boroughs.

"Section 3—No aircraft in the air over the limits of the city of New York shall be guided or controlled by the pilot in a manner designed to give any demonstration of trick flying or aerial acrobatics, or be given any manipulation of the controls which may tend to divert the aircraft from a normal flight with every consideration for stability and safety.

"Section 4—No aircraft shall fly over any part or section within the limits of the city of New York at a height lower than that enabling such aircraft to glide in any emergency and at all times to a known, established or recognized open or unobstructed place on land or water, nor shall aircraft under any circumstances, special or otherwise, fly at a height lower than 2,000 feet except at the beginning or end of a flight.

"Section 5—No person in aircraft shall cause or permit to be thrown out, discharged or dropped any ballast, instruments, tools, containers, handbill, circular, card or other matter whatsoever, unless it be directly over a place established for that purpose, and all equipment carried in aircraft shall be securely fastened in place before leaving the ground.

"Section 6—Aircraft approaching each other head on from opposite or different directions shall alter its course to the right in passing.

"Section 7—Lighter-than-air craft shall at all times have the right of way over heavier-than-air craft.

"Section 8—Every person violating the provisions of this ordinance shall be guilty of a misdemeanor and upon conviction thereof shall be punished by a fine of not less than $50 or imprisonment not exceeding one year, or both.

"Section 9—This ordinance shall take effect immediately."

S. A. E. Report on Commercial Air Navigation

Owing to the importance of outlining a definite program which would be of value in protecting commercial aviation against adverse legislation, the council of the Society of Automotive Engineers charged the aeronautic division some time ago with the preparation of a special report outlining desirable regulations for commercial air navigation. The subject was referred to the aeronautic subdivision on performance and testing and a meeting was held at which the following recommendations were adopted:

A system of federal registration of all aircraft for identification and in addition, licenses for certain specific purposes or uses should be adopted.

All aircraft carrying passengers for any purpose, or goods in commercial service, should be licensed by the federal authority, which license shall indicate the aircraft licensed has complied with certain minimum requirements as to safety. By passengers is meant any person not a necessary member of the crew.

Any aircraft not coming under the classification in the previous paragraph may be licensed by the federal authority even though not complying with the safety requirements, but only for restricted service with a view to minimizing danger to persons or property on the ground. This is intended to cover experimental and special racing aircraft as well as privately owned aircraft not used in commercial or government service. Minimum requirements should, even as regards the structural strength, be reduced to rules and figures capable of application in inspection except by persons of adequate engineering training in this field, and other necessary minimum requirements regarding safety of operation are the result of compromise and can only be applied by persons with trained judgment.

Any definite requirements or figures should not be written into legislation at this time, because these matters would be handled best by the regulation and ruling of the federal authority which should be created by legislation.

Aircraft, which, in accordance with previous paragraphs, require a license, should be periodically inspected to insure that they continue to be in a safe operating condition.

Kosciusko Squadron Members Decorated

Nine members of the Kosciusko Air Squadron, made up chiefly of Americans, were decorated recently with the highest military honors of Poland and, simultaneously with the presentation of the medals, each aviator was kissed on the cheek as is the Polish custom by General Stanislas Haller, commander of the Sixth Polish Army. The presentation took place at the squadron airdrome near Lemberg which city was defended by the Americans during the Bolshevik drive in August.

Those decorated were Capt. Geo. M. Crawford, Brooklyn, N. Y.; Lieut. Eliott W. Chess, El Paso, Tex.; Lieut. Harmon C. Rorison, Wilmington, N. C.; Lieut. Kenneth O. Shrewsbury, Charleston, W. Va.; Lieut. George Weber, Peking, China; Lieut. Wladyslaw Konopka and Alexander Senkowski, the last two named being liaison officers.

The list of those decorated also includes the name of Capt. Merian C. Cooper, of Jacksonville, Fla., who at last accounts was a prisoner in the hands of the Bolsheviks, having been shot down in his airplane last summer.

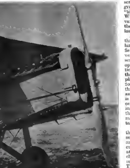
Lieut. Col. Cedric E. Fauntleroy, commander of the air forces of the southern front, and Lieut. Edwin Noble, of Boston, wounded early in the spring, were decorated previously.

Hart Reversible Pitch Propeller

As has been generally known the Engineering Division of the Army Air Service has for sometime past been making experiments and tests with an air screw the pitch of which is not only adjustable but reversible. The feature of actual reversibility is of greatest importance on account of its possibilities and significance in future airplane development and operation.

As will be seen from the accompanying illustrations the principle of operation is the turning of two separate blades in ferrules which form a part of the hub proper. This metal hub and ferrule contain the operating mechanism, by means of which the blade angles are changed during flight. It is necessary, of course, to reduce the speed of the propeller while passing through the neutral pitch position in order to prevent the engine from "racing". The pilot controls the angle of blade setting from the cockpit.

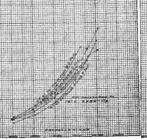
It is not difficult to imagine the advantages that will accrue with an air screw the pitch of which can be altered at will. It will be of very great assistance in high altitudes flying in conjunction with the supercharger for by means of the supercharger the engine's power being kept normal, it will be now possible to almost reproduce sea-level flying conditions by giving the propeller greater "bite" on the rarified air. Without it much of the advantage gained by the use of the supercharger would be lost.

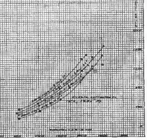


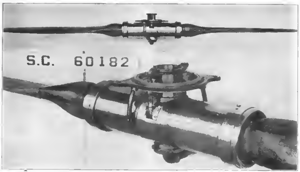
The Hart Reversible Pitch Propeller Mounted on a DeHaviland-4 Airplane

A very valuable use for this propeller should be in landing in small inaccessible fields. The pitch can be reversed, the thrust of the screw made to act in the opposite direction and function as a brake thus reducing the usual run after the airplane strikes the ground before coming to a stop. In this connection, the effect of an adjustable blade propeller is most interesting. With a certain pitch maximum climbing speed can be had but this same pitch will not give maximum effect in horizontal flight.

With this new arrangement then, it will be possible to so set the angle that quick climb and "get-away" can be secured and then once arriving at the desired altitude again choose the blade setting best suited to horizontal flight. This means that the operation of craft over water will be greatly assisted and that landing and taking off from the decks of ships, etc. will be much easier than previously. In addition, it may be possible in the application of this propeller to use the same air screw for various types and powers of engines, by varying



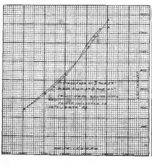


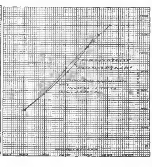


Two Detailed Views of the Hart Reversible Pitch Propeller

the blade angle and thus adapting the screw to existing conditions.

Tests of specimens have shown them to operate successfully and safely and have proven that while small refinements may have to be made, the fundamental design and principle is correct. In fact destructive whirling tests, etc., of standard duration and severeness have been made and results have been very satisfactory. In the development of this new airplane accessory a distinct advance has been made in airplane design. In the tests of air screws of this design certain interesting results are shown in the attached curves made up from test data.





Training Reserve Air Officers

In a letter of November 1, 1920, from the Adjutant General of the Army to the Chief of Air Service, the Air Service was authorized to proceed with the plan for organization of Air Service units of the R.O.T.C. at selected colleges. Subsequently, authority was obtained to establish five units, one at each of the following universities, with the officer in charge as noted:

Massachusetts Institute of Technology, Cambridge, Mass., Capt. Wm. B. Wright; University of Illinois, Urbana, Ill., Capt. John G. Whitesides; Agricultural and Mechanical College of Texas, College Station, Texas, Major C. W. Russell; University of California, Berkeley, Cal., Capt. W. A. Robertson; University of Washington, Seattle, Wash., Major H. C. K. Muhlenberg.

No other units are authorized for the present academic year although it is possible that one additional unit may be established at the Georgia Institute of Technology. For the academic year 1921-1922 it is estimated that about twelve units will be established and requisitions for appropriation from Congress have been made with this project in mind. The Chief of Air Service has been authorized to circularize various other institutions during the present year in order to decide where additional units may best be established for the coming year.

Numerous requisitions for Air Service R.O.T.C. units from institutions all over the country have been disapproved since only the five mentioned are authorized and it was decided not to establish more units than could be efficiently handled by the personnel available. It is the policy of the Chief of Air Service to give any information possible relative to Air Service R.O.T.C. units to any institutions which are interested in military aeronautics.

The program of instruction and training for Air Service units of the Reserve Officers Training Corps has been approved by the War Department for the academic year 1920-1921. At each institution where an Air Service unit is established the Air Service officer detailed to conduct the courses prepares a detailed schedule for this unit. In preparing this schedule he is governed by the scope of instruction prescribed in the curriculum. The schedule of instruction will prescribe the time to be devoted to each subject in the course and the division of this time into theoretical and practical work. The detailed curriculum is so arranged that:

(a) Students completing the first years of the course will be trained to perform the duties of non-commissioned officers of the Air Service in time of war or emergency.

(b) Students completing the entire course will be trained to perform the duties of junior officers of the Air Service in time of war or emergency.

(c) Local conditions will be satisfied and the schedule will be acceptable to the authorities of the institution.

(d) The course must be popular with the student body of the institution.

A minimum of three hours per week during the first two years of the course, and of five hours per week during the last two years, must be devoted to military, including special Air Service instruction. The professor of military science and tactics is to arrange his schedule so as to make use of any additional time that the authorities of his institution may authorize for military instruction.

Certain of the subjects prescribed in the course of instruction will be covered by courses in the regular college curriculum. Credit for military work in these subjects will be given to those R.O.T.C. students who take these courses, and separate military courses in such subjects will not be established. Every effort will be made to increase the number of subjects which can be handled in this manner.

For the Air Service R.O.T.C. Senior Units there will be two separate courses of instruction; one for pilots and observers heavier-than-air (airplane), and one for pilots and observers lighter-than-air (balloon and airship). Both of these courses are not necessarily taught at each unit. As each university is designated it will be stated for the information of the professor of military science and tactics which of these two courses are to be used. Students will be instructed and trained in the duties of a private in the first year of the basic course and should be given an intensive course in close order drill.

The second year basic course will similarly instruct and train students in the duties of non-commissioned officers, and all second year men should be exclusively employed at formations in that capacity. They should not be employed as privates unless they have failed in the preceding year to properly qualify in these duties. In the event that there are more members in the second year than there are non-commissioned officers' positions, the permanent force may be appointed as the professor of military science and tactics elects, the remaining students being appointed lance corporals. There should be a rotation of duties for both the permanent non-commissioned officers and the lance corporals so as to insure varied training for all.

As experience demonstrates that any permanently appointed non-commissioned officer is not efficient in his position be should be reduced to lance corporal and a proper appointment made to insure that the permanent appointees are the most competent. In the event that a proportion of the second year men are designated as permanent non-commissioned officers, they will wear the insignia as such. The remainder will be designated as lance corporals, will wear the insignia, and at formations will be posted as file closers or formed separately, unless regularly posted as non-commissioned officers.

Students given this course will not be permitted to enroll for the advanced course unless they have satisfactorily qualified in the duties of a non-commissioned officer.

The members of the first year advanced course will be instructed and trained primarily as commissioned officers. This will not preclude their serving in subordinate capacity or receiving instruction in subjects not previously covered in the course. These students will be rotated in duties and permanently commissioned in accordance with the general principles explained for the second year basic course. Surplus officers will be rated as additional second lieutenants and treated accordingly.

The fourth year men in the second year of the advanced course will be trained primarily in the duties of captains and should be given as frequent opportunities as may be possible to perform the duties of such higher cadet officers as may exist in the cadet corps.

The grades of captain and field officer may be filled permanently as the professor of military science and tactics and the institutional authorities may prescribe.

In view of the hazard of flying airplanes and the consequent effect on the morale of R.O.T.C. students in the case of serious accidents, it is not considered at all desirable that R.O.T.C. students in heavier-than-air courses be given any flying as part of the regular course until after graduation from the university. The basic camp at the end of the sophomore year will be voluntary, those students who wish to attend being sent to a basic infantry camp during this period. Flying will be conducted at the advanced training camp after junior year, attendance at which will be compulsory for Air Service units. At the advanced camp competent flying instructors will instruct R.O.T.C. students in aerial observation.

At the end of senior year students who have satisfactorily completed the course and desire a Reserve commission will be commissioned in the Air Service Reserve as second lieutenants and as many of them immediately ordered to active duty as the War Department may direct, this number to be determined by the funds available after a proper allotment has been made among all the arms and services.

Whenever appropriations permit, all qualified students who desire Reserve commissions will be ordered to active duty. This active duty period will not exceed six months, during which time they will receive primary and advanced instruction in flying at both primary and advanced Air Service flying schools. A certain percentage of these officers on active duty who are not found qualified for flying duty but have demonstrated proficiency otherwise, will be sent to an Air Service special service school of photography, armament, communica-

tions or engineering for special training during the six months period. Students in the advanced course, lighter-than-air, may be given some practical aerial instruction prior to their graduation.

No students will be admitted to the advanced course for Air Service units until they agree in writing to attend the advanced training camp and if commissioned upon graduation to be immediately ordered to active duty for a period not to exceed six months. During this period of active duty all students will receive advanced flying training at specialized flying schools and a short period of service with an Air Service unit and will receive full pay and allowances of an Air Service flying officer. Upon completion of this six months active duty period recommendation will be made to the War Department that certain students who have demonstrated exceptional ability as commissioned officers be commissioned as second lieutenants in the Regular Army Air Service to fill existing vacancies.

It is contemplated to eventually establish a small airship at the lighter-than-air R.O.T.C. Courses where practical instruction may be given in navigation of air-ships and in observation work from captive balloons. This practical work will be amplified at the summer camp and during the subsequent period of active duty.

A syllabus has been prepared which will give a general idea of the course as planned. The main course for the first year includes principles of the organization and administration of a company or squadron, military hygiene, military courtesies and customs, interior guard duty, physical training, infantry drill, pistol and rifle instruction and practice, theory and practice of communications, history of aeronautics, and Air Service organization.

The basic course for the second year includes, military sketching and map reading, military routine, Air Service weapons, minor tactics, radio, and range work.

The advanced course for the first year includes, field engineering, physical training, minor tactics, liaison for all arms, communications, and aerial photography.

The advanced course for the first year for the lighter-than-air students includes, aerodynamics of balloons, perspective, artillery material and methods (including use of balloon observation in artillery fire, methods of communication, observation of fire, high power artillery, trench artillery), cooperation with infantry, general observation and surveillance, balloon instruments (including field glasses, anemometers, altimeters, compasses, thermometers, parachute knives, barographs, statoscopes, maps), aerostatics, structure of airships, types of airships, the atmosphere, airship gases, load of airships, and principal static laws governing airships.

The advanced course for the first year for the heavier-than-air students includes, aeronautical engines (engine action, carburetion, ignition, lubrication, cooling, trouble shooting, types, shopwork, engine testing), aerial gunnery, aerial bombardment equipment (drop bombs and fuses, bomb sights, bomb and flare releases, and bomb sighting).

The advanced course for the second year includes, military history and policy of the United States, military law, administration, radio, aerial navigation and meteorology, Air Service organization, operation and tactics, and duties of Air Service officers.

The advanced course for the second year lighter-than-air students includes, advanced aerodynamics (resistance of the atmosphere, stability of airships, airship control in flight, dynamic lift), airship instruments (theoretical instruction), construction, maneuvering, maintenance and gases, power units, construction of hangars, doors and windbreaks.

The advanced course for the second year heavier-than-air students includes, theory of flight, nomenclature, rigging, materials and stresses, fabrics and dopes, wire and fittings, propellers, repair of machines, instruments, types, aeronautical engines, and Air Service Service Schools.

At the advanced camp for lighter-than-air students theoretical and practical instruction is given in general orientation from balloon and from elevated observation posts, locating active hostile batteries, simulated by mirror flashes, smoke puffs and hydrogen guns from the balloon at altitudes varying from 2,500 to 4,000 feet. Twenty-four hours of flights are required, some at night. Twenty-four adjustments of various types of fire are scheduled. Free balloon training will consist of five flights, one at night, of a minimum of one hour each. The student will act during these flights in one of each of the following capacities: recorder, pilot, assistant pilot, and change of ballast. As part of the work the student will learn to pack his own parachute and drop it from appropriate altitudes. Instruction will be given in the practical handling of captive balloons, balloon winches, machine guns, hydrogen and helium.

At the advanced camp for heavier-than-air students practical instruction will be given in aerial navigation, range firing with machine guns, trap shooting, drill, and camp routine. After the senior course and during the active duty period, practical instruction in flying airplanes will be given at special service schools of the Air Service with a final period of duty with an Air Service tactical unit.

Pigeons Useful in Naval Aviation

Some very interesting statistics have recently been compiled in the Navy Department concerning the part played by pigeons in Naval aviation during the world war.

During the last ten months of the war, U. S. Naval pigeons delivered 219 messages from seaplanes forced to land at sea. These planes were without any other means of communication, and credit must be given the pigeons for the saving of both men and machines.

The most thrilling experience of any of our aviators is that credited to Ensign E. A. Stone, U. S. N. R. F., who with Sub-Lieut. Eric Moore of the Royal Naval Air Force clung for eighty hours without food or drink to the underside of a seaplane pontoon. The duty of the above officers was convoying patrol, and having met their ship coming from the westward they sighted a periscope ahead and started in pursuit. They unfortunately lost their course in a slight fog, and at 11.30 a.m. were forced to land on the surface in a rough sea, their engine completely dead.

Two pigeons were aboard, and these were released at fifteen minute intervals. The first pigeon arrived at Dunkirk with a message stating the whereabouts of the aviators and that their ship was sinking. Every available seaplane on the station was sent out in search, and although some of them flew as close as 800 ft. from the wreckage and were easily discernible by the men in the water, eighty hours had elapsed before the aviators were rescued. Lieutenant Moore lost six of his toes from gangrene, finally dying in the hospital. Ensign Stone recovered, and until recently was stationed at the U. S. Naval Air Station, Anacostia, D. C.

Many instances have occurred where pigeons operating on this side of the water have been instrumental in delivering messages requesting spare parts to be sent disabled planes, and one pigeon at Cape May is credited with the rescue of one of our pilots off the Jersey coast last winter.

A recent order issued by the Navy Department requires that Navy seaplanes, while in flight, carry pigeons aboard.

Conveniently Arranged Lathes

The lathe is generally accepted as the most important universal machine tool. The Cincinnati Lathe and Tool Co. are supplying lathes of standard types that are particularly conveniently arranged for airplane work. They are known as Cincinnati Geared Head Lathes and require a constant speed drive only as all changes are made in the head. A plate shows the speed of the spindle for each of the various settings of the control levers. The drive shaft in the head operating at constant speed carries two sliding gears meshing with gears on the intermediate shaft. When the gear to the left on this shaft is in mesh with the gear on the intermediate shaft, it gives the first six changes of low speed. When meshing with the gear to the right on this same shaft the additional changes for the higher speed are obtained. The shafts in the head are of high carbon nickel steel. The gears on the back gear shaft and also the direct driving gears are made of steel forgings heat treated. All of the others are of high carbon nickel steel, bushed throughout with bronze. Only the gears actually used for driving are in mesh.

Review of Aviation in 1920

A review of the progress and achievements of aviation in 1920 which has just been prepared by the Manufacturers' Aircraft Association says in part:

Despite many handicaps such as lack of aerial laws, landing fields and a strong government policy, aircraft designed and built in America maintained a high rate of efficiency during 1920. Decreased production and a general contraction in the aeronautical industry, generally, is offset by the more encouraging records of performance made in American aviation.

While the last twelve months have not brought the definitely outlined policy of federal jurisdiction required to assure steady and economical progress in commercial aerial navigation, they have witnessed remarkable achievements by American pilots flying American machines.

Commander A. C. Read, hero of the trans-Atlantic flight in the NC-4, commanded the same flying boat on a noteworthy expedition from Rockaway, Long Island, down the Atlantic Coast, along the Gulf Coast and up the Mississippi River to Cairo, Ill. When the NC-4 returned to Rockaway January 27 last, it had flown 7,740 nautical miles. Three of the four Packard Liberty engines had operated without trouble during the 118 hours in the air, the fourth more than 82 hours. Along the Mississippi the engines were run on commercial gasoline picked up from point to point enroute. Read reported that the greatest difficulty encountered was lack of proper maps.

Compared to long flight attempts conducted by European governments the American ventures were particularly successful. No less than four expeditions attempted to fly the 5,206 miles from Cairo to Capetown, Africa. Col. P. Van Ryneveld and Major C. J. O. Brand finally completed their flight on March 20, in a DH 9 plane sent up by the government of the Union of South Africa after their Vickers-Vimy machine had crashed. They had set out from Cairo February 19. None of the machines that started reached Capetown.

Different success attended the Alaskan Flying Expedition of the U. S. Army Air Service. Four Gallaudet remodelled DH-4B planes, each powered with a single Liberty engine, and carrying two persons, flew from Mitchel Field, Long Island, to Nome, Alaska, and return in 112 hours flying time—a total distance of 9,000 miles, without an accident serious enough to delay the party. Rain and fog caused most of the difficulty in flying over country not even charted on the maps.

The Air Mail in 1920, operating between New York and Washington, New York, Cleveland, Chicago, Omaha, Salt Lake City and San Francisco, transported approximately one hundred million letters at ordinary postage rates. The system was extended in 1920 from Chicago to SanFrancisco, from Key West, Fla., to Havana, Cuba, and from Seattle, Wash., to Victoria, B. C. About 35 Air Mail planes are in the air each day, flying a total in round trips of about 8,000 miles.

During the year the Navy has been making an aerial survey of the Panama Canal Zone.

The Geological Survey has cooperated with the Marine Corps in mapping the coastline of Haiti. American seaplanes, Curtiss, Aeromarine and Boeing types, have operated on passenger routes in China.

Major R. W. Schroeder, flying an American designed and built Packard-Lepere biplane, went up from McCook Field, in Dayton, Ohio, on February 26, and reached the world's record altitude of 33,090 feet.

There were many other experimental flights made successfully. Edward Musick flew an Aeromarine flying boat off the ice at Raritan Bay, N. Y., on March 13, and carried provisions to the steamship *Princess Anne*, stranded near Rockaway, L.I. While the passengers were removed before Musick arrived, his flight demonstrated that flying boats could take off and land on ice or snow, and that they are invaluable in rescue work at sea.

Realizing the urgent need for laws controlling aerial navigation, several legislatures considered state legislation, but the New York state legislature after considering the subject carefully, adopted a resolution asking Congress to enact a federal law before the states passed conflicting legislation.

Practically the entire country was flown over during the year. Lieuts. H. R. Harris and A. L. Smith on March 8 flew a Martin 12-passenger Army transport plane from Dayton, O., to Washington, D. C., a distance of 385 miles, in three hours and thirty-one minutes. Major L. H. Smith on March 6 flew from Camp Lewis, Wash., to San Diego, Cal., in a Boeing DH-4B plane, 1,160 miles, in nine hours and forty-two minutes, most of it over mountain ranges 7,000 feet high.

On March 30 radio communication was established between a submarine and a seaplane at Anacostia, D. C. Roland Rohlfs, former holder of the world's altitude record, on April 12 flew a Curtiss "Wasp" seaplane over a measured course at Rockaway, at a speed of 138 miles an hour. Clifford Webster on April 25 flew a Curtiss HS 2-L flying boat with two passengers 1,345 miles from Florida to New York in eighteen hours and twenty-seven minutes. In April, Paul Wilson flew a Thomas-Morse biplane from Ithaca, N. Y., to Washington, D. C., and return by way of Dayton, Ohio. An Orenco "Tourister" piloted by Clarence Coombs on April 30, carried four persons to a height of 17,150 feet.

The first annual intercollegiate championship airplane races were held at Mitchell Field, L. I., on May 7, Yale, Williams and Princeton winning in the order named.

On May 27 a Dayton-Wright aerial coupe reached a height of 19,710 feet with four persons.

On June 12 Donald Hudson in a Curtiss "Wasp" crossed the Andes mountains at an altitude of 30,000 feet above sea level. On June 27 a Junker monoplane flew from Omaha, Nebr., to Lancaster, Pa., without stopping. On July 3 Aero Limited flying boats carried a ton of grape fruit from Miami, Fla., to New York in sixteen hours. The "Bankers Special" as the Aeromarine F-5-L Navy Cruiser was known, flew from New York to Southampton, Long Island, on July 30, with fourteen passengers, a distance of 110 miles in 72 minutes. Two Junker monoplanes which left New York July 29 arrived in San Francisco August 8. A Gallaudet Liberty Tourist biplane flew a special edition of the New York *Evening Post* from New York to the Roosevelt notification ceremonies at Hyde Park.

On August 12, Lieut. A. G. Hamilton made a world's record parachute drop, jumping from a plane 20,900 feet in the air over Carlston Field, Fla. He reached the ground in twelve minutes. On August 13 Miss Laura Bromwell broke the world's loop-the-loop record for women at Curtiss Field, Garden City, Long Island, looping eighty-seven times in a Curtiss Standard biplane.

On September 5 the U. S. Army Air Service conducted successful experiments with the variable pitched propeller, stopping planes within seventy-five feet of where the the wheels first touched the ground. The same month Californian canneries employed seaplanes in locating schools of fish, reporting larger catches at less cost of time and money.

The New York-SanFrancisco Air Mail system was opened September 8. The continued use of aircraft for commercial purposes led the American Legion at its national convention in Cleveland, Ohio, September 28, to adopt a resolution urging Congress to enact laws regulating aerial transport.

The Gordon Bennett Airplane Race was held at Etampes, near Paris, on September 27. On September 28 an airplane piloted by Paul Collins demonstrated fireproof paint at Curtiss Field, Long Island. Air Service officials saw the plane set afire in mid-air and fly unharmed until the gasoline, which had been poured over it had burned away. The L. W. F. "Giant" three Liberty-engined bomber, America's largest airplane, was accepted by the Air Service after trials at Mitchel Field, Long Island, September 29.

On October 21 a group of British scientists sailed from Norfolk, Va., for the Antarctic regions. They carried an airplane with which it is proposed to survey the west coast of the Weddell sea and Graham Land. On October 23 the "Santa Maria" and "Pinta," Aeromarine flying cruisers, flew from New York to Key West to enter a passenger and mail service between Key West and Havana, Cuba. On October 28 a Curtiss single-engined "Eagle Aerial Pullman" flew over New York City with nine men and women aboard.

After a series of experiments the U S. Navy on November 10 announced that the radio telephone could be used from aircraft to landing stations up to a distance of 300 miles. On November 11 it was announced that the Royal Canadian Mounted Police would in the future use airplanes and flying boats extensively for outpost duty. Two American Standard Wright machines flew from Nebraska to Mexico City to attend the inauguration of the Mexican president. On November 21 the Goodyear company established a dirigible passenger service between Los Angeles and Catalina, Cal

On Thanksgiving Day more than thirty airplanes raced over a course at Mitchel Field, Long Island, for the Pulitzer Trophy. On November 30 the National Aircraft Underwriters Association at its annual meeting adopted a resolution recognizing the increasing popularity of aircraft and urging the need of federal air laws. Early in December, Pilots Smith and Christenson set a new record for the Air Mail, flying 16,000 letters from Chicago to New York in five hours and fifty-six minutes.

Through the operation in 1920 of a few aircraft lent to the Forestry Service by the Army, approximately $35,000,000 worth of timber was saved from destruction by fire, more than the total Army Air Service appropriation for the fiscal year About 1,000 fires were reported

The Wright Aeronautical Corporation of Paterson, N J, produced a cannon motor discharging 1½ inch shells through the propeller shaft of an airplane in flight.

A Curtiss Seagull flying boat made a 1,100 mile demonstration flight to all the principal islands of the Philippines carrying mail, passengers and merchandise

During the year photographs and motion pictures were made of isolated and inaccessible regions of the United States, from airplanes such as, the Yosemite Valley, Mt Ranier, Mt. Hood, the national forests, the St. Lawrence River, the Mexican border, the great deserts of the southwest, the Gulf Coast, the Mississippi River, the Great Lakes, the Apalachian Mountains, the Canadian Rockies, the Sierras. These and other sections were viewed from above by tourists and photographers.

Use to be Made of English Airships

A report from England states that the Air Ministry has decided to turn the airships R-36, R-37, L-64, and L-71 over to the Department of Civil Aviation while the R-33 is being temporarily lent by the R.A F They are to be used to collect data for the commercial operation of airships and Pulham airdrome will probably be used as the headquarters There is no intention of embarking on commercial services, the sole purpose being to gain information as to the possibilities In event of it being demonstrated that it is entirely practicable to operate airships on an airway, as every one connected believes, the airships will probably be acquired by some commercial concern

The R-36 will probably be used in the near future for long distance demonstration flights The first of these will probably be to Egypt and return. Mooring out experiments will be conducted and data concerning meteorology and radio obtained first hand.

U. S. May Get German Air Equipment

Representatives of the Army and Navy will shortly confer, with the Interallied Aeronautical Commission which is in charge of the distribution of air equipment turned over by Germany to the Allied governments. The U S Navy representative is Lieut Frederic P. Culbert, U S N now in Europe on duty in connection with the Navy dirigible R-38. Recommendation has been made to the War Department for the appointment as the Army representatives of Major Benjamin D Foulois, U. S A., now on duty in the office of the military attache at The Hague, and Major Frank M Kennedy, U. S. A Action on the distribution, it is understood, will not be taken until late this month

Massachusetts Institute of Technology.

Courses of instruction in aeronautics have been resumed at the Massachusetts Institute of Technology The course is taken by 10 students including a detail of 8 Army officers. The wind tunnel is now available to private testing, although it is understood that Army testing is still carried on

Navy Balloon in Noteworthy Flight

The Navy free balloon A-5598 piloted by Lieut. A L. Kloor, and having Lieuts. Stephen A. Farrell and Walter Hinton aboard as passengers took off from the Naval Air Station at Rockaway Point a little after noon on Monday, December 13 and shortly afterwards disappeared A message was received by carrier pigeon about two hours later stating that the balloon was then over the Brooklyn Navy Yard. No authentic information was secured until January 2 when the following telegram was received from the crew

"Driven by storm Monday, 12-13, west by north, at lower Hudson Bay, forced to land 2 p m, 12-14, about ten miles north by east of Moose Factory, Ont. Latitude 51.50, longitude 81.00 Lost in forest four days. Crew safe at Hudson Company post. Will leave on first available means of transportation to railroad, which is by dog sled, and will take about nine days. Leaving here Monday, December 27"

Many reports came from various parts of New York State that the balloon was lost in several different localities. Army aviators were sent to Albany and Glens Falls to search for the missing balloon as the snow made it very difficult for searching parties to proceed on foot.

One of the striking features of the adventure was the prediction made by Sir Ruppert Stupart, head of the Dominion Meteorological Bureau He said in part,

"We figure that at 8 30 a. m. on December 14, it was north of Ottawa and south of the line of the Canadian Pacific Railroad But the Canadian authorities figured it was north of the railroad at that time. If the Ottawa men are right the balloonists ought to report some time from around Hudson Bay I am sure they are in the area known as the 'Light Triangle' That would place it in the vicinity of the St. James Bay, a lower arm of Hudson Bay."

The principal factor that caused the pilot to continue in the air was the intensity of the storm on the night of December 13. The next morning they were over forests with no sign of human beings Their best move seemed to be to continue on to Hudson Bay where they would be able to reach some of the Hudson Bay Company's factories They finally landed on the shore of James Bay and were using the compass to reach civilization when they found an Indian by the name of Tom Marks Marks did not want to meet them but was finally caught and persuaded to guide them to Moose Factory at the mouth of the Moose River

The party suffered greatly from cold due to lack of proper clothing and equipment Lieut Farrell was severely frostbitten and has had to be carried on a sled most of the way down to the "line" at Mattice. The only news that has been received has been in the form of letters to the wives and friends of the three men. As these letters were not for publication the information contained was rather sketchy and merely intended to reassure the immediate families of the aeronauts

It was reported that the Canadian authorities had instructed the mounted police to arrest the three men on their return to civilization for landing at spot not designated for international traffic and for wearing an alien uniform There appears to have been very little foundation for the report but the assumption is a natural one owing to the lack of aviation laws and treaties in the United States

The start from Moose Factory was made on December 28 and the party encountered many delays on the way. They arrived at Mattice, Ont., on January 11 A large crowd of newspaper reporters and government officials were waiting for them Elaborate preparations were made for their welcome and all the facilities of the town were employed to make their reception express the feeling of the inhabitants.

Pulitzer Course Measured

At the request of Brig-Gen William Mitchell, the Coast and Geodetic Survey has measured the length of the Pulitzer Trophy Race course and find it to be 29.0202 miles. This figure is accurate to within one foot. This is the length of the course and not the distance that the competitors flew as it is impossible to fly exactly over any triangle on the ground, some deviation must be made to round out the corners. Hence the actual speed of the machines is greater than would appear from calculation, how much it is impossible to say.

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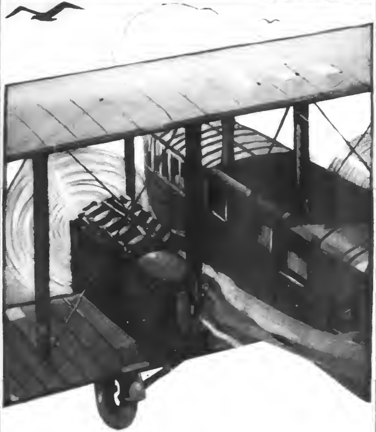

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